

Version of Substitute Specification With Markings to Show Changes

**Electronic Timepiece With Checking Function, And Its Checking Method
Therefor**

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BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to an electronic timepiece operating by the power supply of powered by a chargerechargeable battery, and to a checking method for the timepiece.

Description of the Related Art

[0002] There ~~are~~ exists a variety of portable electronic timepieces such as wristwatches and ~~electrical~~ electric clocks. Some of these timepieces have ~~chargeable~~ rechargeable power source such as ~~chargeable~~ rechargeable batteries or large-capacitance capacitors. ~~And in some others have removable, battery units are constructed as removable unit.~~ In these timepieces, time-keeping units and digital (or analog) displaying units for displaying time ~~conduct operation operate by using the electrical~~ electric power stored ~~on in the batteries~~ power source.

[0003] FIG. 11 ~~shows~~ is a flowchart showing ~~one an example of a manufacturing process and a checking process for a timepiece with a battery and a charging means for the battery.~~

[0004] ~~As for In~~ FIG. 11, discharging step ~~(step A101) is done~~ conducted before the remaining steps in the manufacturing process of the ~~electrical~~ electric timepiece.

[0005] In ~~this~~ discharging step A101, by ~~using~~ use of an external discharging circuit, ~~for example as such as that shown in FIG. 12, the battery alone is discharged alone.~~ In the external discharging circuit 100 shown in FIG. 12, a plurality of ~~(n piece of) batteries (i.e. n batteries)~~ from BA1 to BAn are placed on a battery ~~placing~~ mounting section 101. Each battery from BA1 to BAn is connected in series to a resistor from R1 to Rn, respectively. A sink type constant voltage power source 102 is connected in parallel to each of the above series-connected resistors and batteries. ~~By In~~ the above-configured external discharging circuit 100, batteries ~~from~~ BA1 to BAn are discharged at the same time. In this case, the number of installation terminals for the batteries in the external discharging circuit

100 ~~have~~ has to be enough for the number of batteries to be discharged at the same time.

[0006] After ~~this~~ battery discharging step (~~step~~ A101), an assembling step (~~step~~ A102) and an exterior installation step (~~step~~ A103) is are conducted. Then a battery charging step (~~step~~ A104) is conducted.

[0007] In this charging step A104, the quality of the charging function of the battery is examined, and enough ~~electrical~~ electric energy for ~~the~~ the ~~timepiece-operation~~ operation ~~in~~ of the next step ~~of~~ (i.e. an operation checking step (step A105)) is stored in the battery. Charging is conducted in the following ways. ~~For example,~~ for ~~In~~ a timepiece ~~with~~ having a rotating type generator, ~~giving a vibration to causing the timepiece to vibrate~~ moves an oscillation weight in the rotating-type generator of the timepiece, and ~~A kinetic energy generated in the oscillation weight in this process is converted by the generator into electrical~~ electric energy, ~~and then the electrical energy which is subsequently stored in the battery. And in other type of~~ In a timepiece such as with having a solar panel, electric energy is generated ~~is conducted~~ by the solar panel, and the generated ~~electrical~~ electric energy is stored in the battery. ~~And~~ In yet in ~~another type of timepiece, it is possible to generate electric energy from use for generation an inductive energy source, in accordance with such as an exterior radio wave or a magnetic force, and to thereby charge the battery.~~

[0008] Confirmation of a charging state is conducted ~~in the following ways~~ follows. ~~In~~ in the charging step, an operator ~~puts~~ activates a charging state display function ~~into action, the charging state display function being that is installed in the timepiece. And the~~ The operator then checks the displaying state of the timepiece, and to confirms whether or not the charging the battery is overcharged.

[0009] ~~The~~ Battery discharging step (~~step~~ A101) ~~mentioned above is done in order is implemented to, at this charging step, control an maintain the accuracy of the monitoring of battery voltage inspection in the charging step to within a certain range.~~

[0010] In ~~the~~ operation checking step (~~step~~ A105), a quality verification for the ~~electrical~~ electric timepiece is conducted. This quality verification comprises timepiece operation verification ~~in~~ at high and ~~cold~~ low temperatures. ~~In detail~~ Specifically, in the operation checking step, a trial operation lasting several hours or several tens of hours is conducted at around an ambient temperature of about 60 degree centigrade of high temperature atmosphere and around at an ambient temperature of about minus 10 degree centigrade of low temperature atmosphere, a trial operation extending several hours or several tens of hours is

conducted. ~~In~~ During this trial operation period, the timepiece is checked for a stoppage and for a delay of in displayed time display is checked. ~~And Then,~~ by confirming a continuous discharging time of the battery after the trial operation, a quality confirmation (judgment) is conducted.

[0011] ~~After the operation checking step A105, a shipment checking step (step A106), with including an exterior checking, and a full-charging step (step A107) to full-fully charge the battery is are conducted, and then the timepiece is shipped (step A108).~~

[0012] ~~Incidentally~~ It is to be noted, in the battery discharging step explained above, discharging the battery is conducted alone is discharged by using the external discharging circuit before the assembling assembly. ~~And and that discharging time requires the battery requires from several to several tens of hours. Therefore, a discharging circuit facility with requires enough number of, for example enough for one day production of timepiece, battery installation terminals for the batteries is necessary for one day's production.~~ Hence, this discharging method is not appropriate for a model produced on a massive scale.

[0013] ~~And Also~~ if, for example, after the shipment, ~~an operation verification operation for of a~~ discharging function is required, it is very difficult for the battery to be made on a certain discharging state discharged to a predetermined level without a discharging facility.

[0014] Moreover, there are several kinds of battery batteries. Even among lithium type battery batteries, discharging characteristics differs, for example, according to types of electrodes, as shown in FIG. 13. ~~And chargeable~~ Also, rechargeable batteries battery has have a characteristic of voltage recovery effect by which, after ~~stopping discharging is stopped~~, voltage rises. Therefore battery voltage is unstable and becomes wide dispersed after discharging. This voltage dispersion after discharging ~~causes a disadvantageous effect~~ adversely affects on the accuracy of checking accuracy.

[0015] ~~And Furthermore by purchasing a certain switch while in the charging step, for example, a charging state, such as charged voltage, is displayed indicated by the an amount of fast-forwarding movement of the analog second hand on the displaying section, by pushing a certain switch.~~ In this case, an external operation such as pushing a certain switch or the like is necessary to confirm determine the charging state. Hence an external input is required, ~~and resulting in a problem of necessitating a further more operation process.~~ ~~And Also, since confirmation is done by a use confirms a charging state by observing the amount of fast-forwarding movement of the analog second hand, if the amount of fast forwarding movement is~~

~~wrongly recognized, there is a possibility that checking result falls in a fault judgment of misjudgment due to human error.~~

[0016] ~~And Additionally~~ in the operation checking step, ~~the quality verification for~~ of the ~~electrical electric~~ timepiece is conducted by checking ~~the its~~ operation under at both a high and low ~~ambient~~ temperatures ~~atmosphere~~. More precisely, quality verification of the timepiece is conducted by checking whether or not the time piece experiences there is a stoppage (continuous time-keeping trouble) or a time delay under the above conditions, the quality verification of the timepiece is conducted. Therefore even when ~~the trouble a problem~~ is detected in the timepiece, it is difficult to ~~identify determine whether~~ the cause of the ~~trouble problem~~ ~~whether it~~ is due to the motor drive unit or due to the battery.

[0017] ~~In order to~~ To confirm that it a problem is due to a motor drive trouble, it is ~~required necessary~~ to examine even a gear train unit ~~for that drives driving an hour hand, a minute hand and a second hand.~~ ~~And in order to do~~ To conduct this examination, it is required necessary to dismantle break the timepiece up by to a considerable extent requiring fine detail. Hence, in order to ~~prevent avoid this complicated breaking up work and dismantling examination procedure,~~ there is a demand for simplifying the distinction that distinction between a problem due to the motor drive trouble and a problem due to another factor be made as easy as possible. However, in the prior arts timepiece, it is difficult to ~~make a distinction distinguish between the a motor drive trouble problem and a problem due to another factor.~~

[0018] ~~And as for the~~ Regarding motor drive trouble, as long as the when a motor is does not apparently appear to be of low poor quality, it is not possible to judge that the trouble is due to the motor. ~~But~~ However, for example, there ~~is somewhat exist some~~ low quality motors which, under some temperature conditions, works ~~and does not without causing a delay.~~ Ideally, ~~this kind of such~~ motors should also be judged ~~as to cause motor problems.~~ However it is difficult to make such a ~~judgement judgment.~~

[0019] ~~By taking the above situation into considering consideration,~~ the object of the present invention is to provide an ~~electrical electric~~ timepiece with a checking function which, for example, in the timepiece manufacturing process ~~enhances improves~~ the checking accuracy and efficiency, and a checking method for the timepiece.

Objects of the Invention

[0020] Therefore, it is an object of the present invention to overcome the aforementioned problems.

Summary of the Invention

[0021] ~~In order to~~ To solve the above problems, in the timepiece of the present invention, ~~a timepiece~~ comprises an external input unit for receiving an external signal, a display section for displaying the time, a battery unit capable of being recharged, a drive unit for driving the display section ~~by using the electrical electric power stored in the battery unit~~, a comparator unit, and a discharging control unit. The comparator unit ~~detects a~~ monitors the voltage of the battery unit, and compares the voltage with a reference voltage. The discharging control unit, ~~when, via the external input terminal, a prescribed signal enters~~ is input via the external input terminal, starts discharging ~~from the battery unit~~, and when the ~~detected result by the comparator unit satisfies~~ detects a prescribed condition, stops ~~the discharging from the battery unit~~.

[0022] ~~By the~~ The present invention, ~~it is possible to~~ provides the following advantages: ~~Being able to check the timepiece operation more accurately and efficiently can be checked with improved accuracy and efficiency;~~ Unnecessity of an external circuit for discharging the battery in the manufacturing process is unnecessary; and ~~Being able to lower the voltage dispersion of the battery can be lowered before and after and before charging.~~

Brief Description of the Drawings

[0023] FIG. 1 is a block diagram showing a construction of ~~the a~~ a timepiece of one embodiment of the present invention.

[0024] FIG. 2 is a flowchart showing a ~~flow~~ process of manufacturing and checking ~~process of the timepiece~~.

[0025] FIG. 3 is a block diagram showing constructions of each part of the timepiece.

[0026] FIG. 4 is a circuit diagram showing the construction of the operation check function control circuit 310 shown in FIG. 3.

[0027] FIG. 5 is a circuit diagram showing a second external input unit measure circuit 311, operation check function mode select circuit 312, a stored electricity unit discharge control circuit 305, a stored electricity unit charging completion detect circuit 306, and a motor drive trouble detect circuit 304 shown in FIG. 3.

[0028] FIGS. 6A and 6B are timing charts showing operation of the operation check function control circuit 310 shown in FIG. 3.

[0029] FIG. 7 is an exemplary operational timing chart showing one example of operations of each unit the structure shown in FIG. 3.

[0030] FIG. 8 is a block chart diagram explaining a discharging current in a motor drive unit E shown in FIG. 3.

[0031] FIGS. 9A, 9B and 9C ~~cooperate to collectively~~ form a flowchart showing flow of operation and checking process of the timepiece of the present invention.

[0032] FIG. 10 is ~~a diagram showing a specification of the operation and checking~~ a diagram explaining modes 1 to 3 of the operation check process.

[0033] FIG. 11 is a flowchart showing an operation and checking process of ~~the a~~ timepiece ~~of~~ according to prior arts.

[0034] FIG. 12 is a circuit showing an external discharging circuit for batteries of according to prior arts for batteries.

[0035] FIG. 13 is a diagram showing discharging characteristics of two types of lithium ~~chargeable~~ rechargeable battery (MT: which uses manganese and titanium for electrode, CT: which uses titanium and carbon for electrode).

Description of the Preferred Embodiments

[0036] ~~From here, by using~~ With reference to the drawings, one embodiment of present invention will be described. FIG. 1 is a block diagram which shows a construction of the timepiece 1 of one embodiment of the present invention. In FIG. 1, the timepiece 1 is a wristwatch. ~~User of this wristwatch wears it by using a belt attached to the apparatus.~~ The ~~electrical electric~~ timepiece 1 comprises a generator system A, a power supply system B, a control unit C, a motor unit D, a motor drive circuit E, a first external input terminal F, and a second external input terminal G. ~~Brief A brief explanations of these parts are as the operation of these components follows.~~ The generator system A generates alternating current. The power supply system B rectifies the alternating current, then stores the generated energy into the battery unit 48, and then raises or lowers the stored voltage, and then supplies ~~the electricity to each constructing parts~~ power to the electrically driven components. The control unit C controls the entire timepiece 1. The motor unit D comprises a second hand 61, a minute hand 62, a hour hand 63, and a stepping motor 10 for moving the hands. The motor drive circuit E is a circuit for driving the stepping motor 10 in the motor unit D, based on a control signal from the control unit C. The first external input unit F and the second external input unit G are means for

changing modes in an operation ~~checking mode-process-in turn~~. This operation ~~check function-process~~ is one feature of the timepiece 1 of the present invention.

[0037] The generator system A comprises a generating apparatus 40, an oscillating weight 45, and an acceleration gear 46. The generating apparatus 40 in FIG. 1 is an electromagnetic induction type AC generator apparatus. The electromagnetic induction type AC generator apparatus comprises a generator rotor 43, a generator stator 42, and a generator coil 44. The oscillating weight 45 is a means for providing the generator rotor 43 with ~~an energy~~. In this wristwatch type electrical electric timepiece 1, the oscillating weight 45 is ~~driven-made~~ to rotate by movement of a user's arm. The movement of the oscillating weight 45 is transmitted to a generator rotor 43, ~~via the an acceleration gear 46, is transmitted to a generator rotor 43~~. Then the generator rotor 43 rotates in a generator stator 42. ~~Then thus~~ voltage is induced in the generator coil 44. The voltage is output ~~to between from~~ two output terminals of the generator coil 44. In this way, in the generator system A, power generation is done-achieved by use of energy related to the user's everyday life.

[0038] The power supply system B comprises a rectifier circuit 47, a battery (a battery unit) 48 and a voltage raising and lowering circuit 49. The alternating voltage from the generator system A is rectified by the rectifier circuit 47 into a direct voltage, and is stored in the battery (the battery unit) 48. The battery unit 48 comprises a large-capacitance capacitor or a ~~chargeable~~rechargeable battery such as a lithium battery. The direct voltage stored in the battery 48 is supplied to the voltage raising and lowering circuit 49. The voltage raising and lowering circuit 49 is a circuit for, by using more than one of capacitors ~~of from 49a to 49c~~, raising or lowering the direct voltage by multiple-times factors. The output voltage of the voltage raising and lowering circuit 49 is controllable by a control signal $\phi 11$ from the control unit C.

[0039] In the structure shown in FIG. 1, ~~a voltage VDD of higher electric potential side of the battery 48 (higher electric potential side voltage)~~ is ~~described-identified~~ as a reference electric potential GND. ~~And a~~ The lower electric potential side voltage of the battery 48 is described-identified as a first voltage low reference VTKN (a first lower electric potential side voltage), ~~And and~~ a second voltage on the lower electric potential side voltage of the raising and lowering circuit 49 is described-identified as a second lower electric potential side voltage low reference VSS. Output voltage of ~~the generator coil 44~~ is input to the control unit C as a control signal $\phi 13$. ~~A voltage value of v~~Voltage VSS is input to the control unit C as a control signal $\phi 12$.

[0040] A motor drive circuit E creates a drive pulse based on a drive clock supplied from the control unit C, and then provides the drive pulse to a stepping motor 10 in the motor unit D. The stepping motor 10 comprises a rotator section. The rotator section rotates by a fixed degree amount when the a drive pulse is supplied applied to the stepping motor 10. The rotation of the rotating part of the stepping motor 10 is transmitted to the second hand 61 by way of a second intermediate wheel 51 and a second wheel 52, both wheels being connected to the rotating part. ~~Then t~~The second hand thus rotates providing an indication of the passage of time in seconds, ~~and the second indication is conducted.~~ And Additionally, the rotation of the second wheel 52 is transmitted to a minute intermediate wheel 53, a minute wheel 54, an hour intermediate wheel 55, and an hour wheel 56. The minute wheel 54 is connected to a minute hand 62. The hour wheel 56 is connected to a hour hand 63. Therefore these hands works together in conjunction with the rotation of the stepping motor 10, ~~And and thereby indicate the passage of time in hours and minutes indications are conducted.~~

[0041] Although not described in the drawings, it is possible to connect other transmission systems to the gear train 50 which is constructed by of wheels from 51 to 56 in order to display a calendar and so on. For example, ~~in order to display a date,~~ it is possible to put add a cylindrical intermediate wheel, an intermediate date wheel, and a date wheel and so on. ~~And Further still,~~ it is possible to put add a calendar correction gear train (such as a first calendar correction wheel, a second calendar correction wheel, a calendar correction wheel, and a date disc).

[0042] The first external input unit F comprises a crown for setting time ~~setting~~ and a circuit for electrically detecting the time-setting operation electrically. In this embodiment, the second external input unit G is used as a switch for starting ~~the an~~ operation check function of the timepiece 1 has. The second external input terminal G is an indicator switch installed on the exterior section of the wristwatch. The second external input terminal G is used ~~when confirming to confirm~~ the charging state of the battery 48. ~~And also~~ Also in this embodiment, the second external input terminal G is used as a switch for inputting a signal to change between modes ~~of from~~ 1 to 3 while ~~operating performing~~ the operation check process (B100). Operation state of the first external input unit F and the second external input unit G is input to the control unit C in ~~electrical~~ the form of an electric signal.

[0043] ~~Here, by referring~~ With reference to FIG. 2, an outline of the operation check process ~~realized in of~~ this embodiment will be described. FIG. 2 is a flowchart showing an example of a manufacturing and checking process of the electrical electric timepiece of the present embodiment. The operation check process B100 is

conducted after the manufacturing process (step A102) and the exterior installation process (step A103). The operation check process B100 ~~is composed of~~ has three ~~processes~~ steps (step B101, step B104, and step B105). These three ~~processes~~ is steps are conducted by using ~~each~~ functions of modes ~~from 1 to 3~~ which ~~the~~ are present in the timepiece ~~has in itself~~.

[0044] The first process (step B101) of the operation check process B100 is ~~corresponding~~ corresponds to discharging step A101 in FIG. 11. The first process is ~~conducted~~ executed as a preparation ~~process~~ step for checking the charging function of the timepiece 1. In ~~the~~ this first process, ~~by use of mode 2 function of the timepiece 1,~~ starts an electrical electric power consumption circuit is put to start, and the ~~electrical power consumption circuit which discharges electrical electric charge stored in the from~~ battery 48, and thereby controllably drops the voltage of the battery ~~is controlled into a~~ to prescribed voltage level.

[0045] The second process step (step B104) of the operation check process B100 is a process for ~~judging~~ determining the efficiency, or a quality, of a charging ~~performance~~ operation. ~~These~~ second process is ~~conducted~~ implemented by a charging-performance-quality-judge function of mode 2 function of the timepiece 1 (~~charging performance quality judge function~~). ~~In more details,~~ More specifically in this second process, the ~~electrical electric~~ timepiece 1 is supplied with a vibration, and ~~thereby the its internal oscillating weight in it is driven to~~ is thereby made to rotate. ~~Therefore~~ Thus, electricity is generated in the generator system A, and ~~charging the battery 48 is done~~ charged. Then, the charging-performance-quality-judge function by the of mode 2 function (~~charging performance quality judge function~~), determines if whether or not the battery's voltage reaches a charging completion charge-complete voltage level within a prescribed charging period of time is judged, and the result of judgement is displayed conveyed to the user by movement of second hand 61. That is, mode 2 determines if the battery is charged up to a predetermined voltage level within a prescribed time period, and outputs the result.

[0046] The third process (step B105) of the operation check process B100 is a process for poor quality detection by operating the timepiece 1. In more details, in this third process, ~~under at high or low temperatures condition,~~ although motor drive circuit E is being able to rotate the stepping motor 10, drive circuit E generates an irregular motor drive pulse, which will result in ~~more electrical higher electric power consumption is generated from the motor drive circuit E~~. Operation ~~under this kind of~~ at these severe conditions enables to detection of motor characteristic trouble, which is not ~~possible to detectable~~ under when generating a

normal motor drive pulse. When the trouble is detected, movement of, for example, the second hand 61 is changed from a normal state to other a different state, and which the state is continued maintained. The user sees that the movement of second hand is different ~~from~~ than in the normal state, and thereby knows that there is a problem with the motor characteristics has some trouble.

[0047] Next, ~~by using~~ with reference to FIGS. 3 to 8, details of each ~~construction part of the timepiece 1 shown in FIG. 1~~ will be described. FIG. 3 is a block diagram showing detail of the construction of the control unit C, and signal flows between units of from A to G. In FIG. 3, blocks of from 301 to 312 are circuit blocks in the control unit C, and those surrounded by ~~broken dashed~~ lines are not.

[0048] The charge detecting circuit 301 receives the output voltage of the generator coil 44 as a generation voltage signal SW ($\phi 13$), and, ~~by in accordance with the signal~~, detects a generation state of the generator system A. ~~And then the circuit 301 outputs the result showing a signal indicating a detection result of the charging state as a charge detect result signal SA. The signal SA which enters into is input to the rectifier circuit 47 in the power supply system B is used as a signal for controlling a rectification operation. The Rectified output of the rectifier circuit 47 is supplied to the battery 48 (the battery unit) 48 as a rectification output signal SB. And a stored voltage signal SC showing the stored voltage (=VKTN) of battery 48 enters is applied to into a raising and lowering circuit 49 and a voltage detecting circuit 302.~~

[0049] The voltage detecting circuit 302 receives the stored voltage signal SC, a stored voltage raising and lowering result signal SD ($\phi 12 = VSS$), and a voltage detect control signal SX. The stored voltage raising and lowering result signal SD is a signal indicating the output voltage of the raising and lowering circuit 49. The voltage detect control signal SX is output from a timepiece control circuit 303. The voltage detecting circuit 302, when the voltage detect control signal SX is active, compares the signal SC, which indicates the stored voltage VKTN, with predetermined reference comparison voltages of DCHRGV and CHRGV respectively, then outputs a voltage detect result signal SN comprised of bits SN1 and SN2 indicating respective comparison results.

[0050] ~~Incidentally~~ It is to be noted that, other rather than direct comparison between the comparing stored voltage VTKN and with the reference comparison voltages, it is possible to compares, instead of the stored voltage VTKN, the raising and lowering voltage VSS with the reference voltages of DCHRGV and CHRGV, and then and to outputs the voltage detect comparison result as signal SN.

[0051] For example, when the raising and lowering circuit 49 is ~~on a state of raising ratio of~~ operated to provide a raising factor of 2, if it is detected that the absolute value of VSS is 1.25 V ~~is detected~~, outputting the voltage detect result signal SN indicating the absolute value of VTKN of 0.625 V gives an equivalent effect.

[0052] The timepiece control circuit 303 uses the output voltage VSS of the raising and lowering circuit 49 as a power source. The timepiece control circuit 303 receives a first and a second stored electricity unit discharge control signals SO1 and SO2 from a stored electricity unit discharge control circuit 305, a stored electricity unit charge completion control signal SP from a stored electricity unit charging completion judge circuit 306, a motor drive trouble judge signal SQ from a motor drive trouble judge circuit 304, a high-frequency magnetic field detect result signal SK from high-frequency magnetic field detect circuit 307, an alternating current magnetic field detect result signal SL from an alternating current magnetic field detect circuit 308, and a rotation detect result signal SM from a rotation detect circuit 309.

[0053] Then the timepiece control circuit 303 generates the voltage detect control signal SX, and supplies it to the voltage detecting circuit 302.

[0054] ~~And t~~The timepiece control circuit 303 generates a motor driving signals SE, SF, SG, and SH, and supplies them to the motor drive circuit E, and also generates a non-rotation detect measure signal SY, and supplies it to the motor drive trouble judge circuit 304.

[0055] The motor drive signal SE is a pulse signal comprised of a normal driving pulse, a rotation detect pulse, a high frequency magnetic field detect pulse, a magnetic field detect pulse, ~~and an auxiliary pulse~~, and so on. The normal driving pulse is a pulse supplied to the motor drive circuit E for a regular motor drive. The rotation detect pulse is a pulse supplied to the motor drive circuit E when detecting whether ~~or not~~ there is a high-frequency magnetic field. The high frequency magnetic field detect pulse is a pulse supplied to the motor drive circuit E for detecting an external magnetic field. The auxiliary pulse is a pulse that is output when the motor fails to rotate by in response to only the normal driving pulse. This auxiliary pulse, ~~and has bigger higher~~ effective electric power than the normal driving pulse. When the auxiliary pulse is generated, the non-rotation detect measure signal SY is generated.

[0056] The motor driving signal SF is a pulse for controlling the motor driving circuit E when discharging the battery 48.

[0057] The motor driving signal SG is a pulse for controlling the motor unit D when charging the of battery 48 is completed.

[0058] The motor driving signal SH is a pulse for controlling the motor unit D ~~to~~ for other hand movement from other than normal hand movement, and, is output when motor trouble takes place, ~~is output~~.

[0059] When a high-frequency magnetic field detect pulse is supplied to the motor drive circuit E as the motor drive signal SE, a bidirectional induced voltage is generated in a drive coil of the stepping motor. The high frequency magnetic field detect circuit 307 is a circuit ~~to~~ detecting existence of a high-frequency magnetic field by comparing a voltage SJ of the induced voltage with the pre-determined reference value for alternating current magnetic field detection.

[0060] When a magnetic field detect pulse is supplied to the motor drive circuit E as the motor drive signal SE, a bidirectional induced voltage is generated in a drive coil of the stepping motor. The alternating current magnetic field detect circuit 308 is a circuit ~~to~~ for detecting existence of an alternating current magnetic field by comparing a voltage SJ of the induced voltage with the pre-determined reference value for alternating current magnetic field detection.

[0061] When a rotation detect pulse is supplied to the motor drive circuit E as the motor drive signal SE, a bidirectional induced voltage is generated in a drive coil of the stepping motor. The rotation detect circuit 309 is a circuit ~~to~~ for detecting existence of a rotation of the drive motor by comparing a voltage SJ of the induced voltage with the pre-determined reference value for rotation detection.

[0062] ~~Incidentally~~ It is to be noted that, a section in the timepiece control circuit 303 for outputting the motor drive signal SE, the high frequency magnetic field detect circuit 307, the alternating current magnetic field detect circuit 308, and the rotation detect circuit 309 are based on known techniques ~~which have been used for~~ controlling a stepping motor drive. For example, the technique is described in Japanese Patent Application Laid-Open Publication No.10-225191 entitled "eControl dDevice for sStepping mMotor, iIts eControl mMethod, and tTime kKeeping dDevice", and Japanese Patent Publication No. 3-45798 entitled "aAnalog eElectric tTimepiece" ~~explain the technique, both of which are hereby incorporated by reference.~~

[0063] An operation check function control circuit 310 receives a first external input signal SR1 and a first external input differential signal SR2. The first external input signal SR1 is a signal output from a first external input unit F, and indicating that a switch (a crown) in the first external input unit F is operated. The

first external input differential signal SR2 is a differentiated signal of the first external input signal SR1. ~~And the~~ The operation check function control circuit 310 outputs an operation check function control signal SS.

[0064] A second external input unit measure circuit 311 receives an operation check function control signal SS and a second external input signal ST. The second external input signal ST is a signal output from a second external input unit G, and indicating that a switch (a crown) in the second external input unit G is operated. ~~And the~~ The second external input unit measure circuit 311 outputs an operation check function mode select signal SU which has two bits of SU1 and SU2.

[0065] The operation check function mode select circuit 312 receives the operation check function mode select signal SU and the operation check function control signal SS. And the operation check function mode select circuit 312 outputs an operation check function mode select result signal SV which has three bits of SV1, SV2, and SV3. The three bits of SV1, SV2, and SV3 of the operation check function mode select result signal SV ~~enters into~~ are input to the stored electricity unit discharge control circuit 305, the stored electricity unit charging completion judge circuit 306, and the motor drive trouble judge circuit 304 respectively. A bit SV1 of the operation check function mode select result signal SV is a bit indicating by positive logic that the operation check function is in the mode 1. The bit SV1 ~~has~~ is at a high level when the mode of the operation check function is in the mode 1. A bit SV2 is a bit indicating by positive logic that the operation check function is in the mode 2. The bit SV2 ~~has the~~ is at a high level when the mode of the operation check function is in the mode 2. A bit SV3 is a bit indicating by negative logic that the operation check function is in the mode 3. The bit SV3 ~~has the~~ is at a low level when the mode of the operation check function is in the mode 3.

[0066] Next, referring to FIGs. 4, 5, and 7, ~~the a~~ a description will be ~~given~~ provided with respect to the operation check function control circuit 310, the second external input unit measure circuit 311, the operation check function mode select circuit 312, the stored electricity unit discharge control circuit 305, the stored electricity unit charging completion judge circuit 306, and the motor drive trouble judge circuit 304.

[0067] FIG. 4 is a circuit diagram showing the detailed ~~construction of the~~ operation of check function control circuit 310 shown in FIG. 3. The operation check function control circuit 310 comprises two 2-bit counters 401 and 402, a 1-bit counter 403, two D ~~flip-flap~~ flip-flops 404 and 405, an SR latch 406, three double-input ORs 407 to 409, a double-input AND 410, a double-input XNOR (exclusive logic addition of negative logic output) 411, and ~~two double-input of positive logic~~

input and negative logic input ANDs 412 and 413 each of which has a positive logic input terminal and a negative logic input terminal.

[0068] An output signal of OR gate 408 is input to In the reset terminal R of the 2-bit counter 401 enters an output signal of the OR 408. A clock signal F1 having a cycle of one second In is input to the clock terminal CLK of the 2-bit counter 401 enters a clock signal F1 having a cycle of one second. The 2-bit counter 401 counts the clock signal F1 when the output signal of the OR 408 has the is at a low level.

[0069] The first external input signal SR1 is input to In the positive logic input terminal of the AND 412 enters the first external input signal SR1. The signal SR1 becomes the is set to a high level when the crown, which is the switch of the first external input unit F₁, is pulled out by two clicks.

[0070] The first external input differential signal SR2 is input to In the positive logic input of the AND 413 enters the first external input differential signal SR2. The signal SR2 is a differentiated signal of the signal SR1. In more detail, the signal SR2 is generated under a case when the crown in a state of being pulled out by two clicks is pushed back by one click or two, the first external input signal SR1 is reset from a high level turns to the a low level from the high level. The signal SR2 is a single pulse signal having a predetermined pulse width.

[0071] The operation check function mode select circuit 312 output the operation check function mode select result signal SV2, which is applied to In the negative logic input of the ANDs gates 412 and 413 enters the operation check function mode select result signal SV2 output from the operation check function mode select circuit 312. When the signal SV2 has the is at a low level, the ANDs gates 412 and 413 output the first external input signal SR1 and the first external input differential signal SR2 as they are.

[0072] The clock signal F1 having a cycle of one second is input to In the clock terminal CLK of the 1-bit counter 403 enters the clock signal F1 having a cycle of one second. The output of AND gate 412 is input to In the active low reset terminal R having the low active of the 1-bit counter 403 enters the output signal of the AND 412. The 1-bit counter 403 counts pulses in the clock signal F1 when the output signal of the AND gate 412 has the is at a high level.

[0073] The data terminal D of the D flip-flop 404 is fixed at the a high level. In t The reset terminal R having the low active of D flip-flop 404 is active low. enters the The output signal of the of AND gate 412 is applied to the reset terminal R of D flip-flop 404. Output XQ of 1-bit counter 403 is applied to In the clock input terminal, CLK, of the D flip-flop 404 enters the output signal

~~of the output terminal XQ of the 1-bit counter 403. Accordingly, under a state that~~
~~the when the output signal of the AND gate 412 has the is at a high level, when the~~
~~output signal of the output terminal XQ of the 1-bit counter rises, the D flip flop~~
~~flip-flop 404 responds to a rise at output XQ of 1-bit counter 403 by reads latching in~~
~~the input signal having high level at its data terminal D which is given to the data~~
~~terminal D and outputs outputting the same from the its output terminal Q.~~

[0074] ~~The data terminal D of the D flip flop~~~~flip-flop 405 is fixed at the a high~~
~~level. In the rReset terminal R having the low active of D flip flop~~~~flip-flop 405 is~~
~~active low and it receives enters the output signal of the from AND 410. The output~~
~~from AND gate 412 In is applied to the clock input terminal CLK of the D flip~~
~~flip flop 405 enters the output signal of the AND 412. Accordingly, when under~~
~~a state that the output signal of the AND gate 410 has the is high level, when the~~
~~output signal of the AND 412 rises, the D flip flop~~~~flip-flop 405 will reads the its~~
~~input high signal having high level which is given to the data at its terminal D and~~
~~outputs the same from the on output terminal Q in response to a rise at the output~~
~~of AND gate 412.~~

[0075] ~~The OR 407 receives the "2¹ " output Q1 of the from 2-bit counter 401 and~~
~~the output signal from the output terminal Q of the from D flip-flop 405.~~

[0076] ~~The output OR gate 407 In the coupled to the set terminal S of the SR latch~~
~~406 enters the output signal of the OR 407. Output Q of D flip-flop 404 In the is~~
~~applied to the reset terminal R of the SR latch 406, enters the output signal from~~
~~the output terminal Q of the D flip-flop 404.~~

[0077] ~~The OR 409 outputs a logical sum the logic OR function of the output signal~~
~~of the output terminal Q of the SR latch 406 and an the output signal of the AND~~
~~gate 413.~~

[0078] ~~The output of OR gate 409 In is applied to the clock terminal CLK of the 2-~~
~~bit counter 402 enters the output signal of the OR 409. The output Q of SR latch~~
~~406 is applied to In the reset terminal R of the 2-bit counter 402 enters the output~~
~~signal of the output terminal Q of the SR latch 406. When the output of SR latch~~
~~406 is at a low level, The counter 402, when the output signal of the SR latch 406~~
~~has the low level, counts the signal SR2 supplied via the AND gate 413 and OR gate~~
~~409. Here, when the output of the OR 407, which is to be a coupled to the set input~~
~~S of the SR latch 406 has the is at a low level, the output Q of the SR latch 406~~
~~becomes the low level by receiving the is reset in response to a high level signal once~~
~~in the at its reset input R.~~

[0079] The 2-bit counter 402 has a "2⁰" output (i.e. Q0) and a "2¹" output (i.e. Q1). These output terminals are connected to input terminals of the AND gate 410. Accordingly, in a case in which the When output Q of the SR latch 406 has the is at a low level, signal SR2 is permitted to pass through OR gate 409 to 2-bit counter 402. Thus, if the output of SR latch 406 is low, when as and three SR2 three-pulse signals are applied to the enter into the 2-bit counter 402, both the outputs (Q0 and Q1) of the 2-bit counter 402 will go become the high level upon the third pulse of signal SR2 and cause the output signal of the AND gate 410 to becomes the high level.

[0080] The output signal of the AND 410 is output as operation check function control signal SS from the operation check function control circuit 310. The signal SS, when the at a high level, starts the operation check function. And the sSignal SS is also input to the active low reset input terminal R having the low active of the D flip-flop 405, as mentioned above.

[0081] The XNOR 411 outputs a high level, when both of the "2⁰" output Q0 and the "2¹" output Q1 of the counter 402 have the are at a low level or both are at a high level, outputs a signal of high level, and XNOR 411 outputs a low level when both Q0 and Q1 of counter 402 at when the levels of them are different levels, outputs a signal having the low level.

[0082] The OR gate 408 outputs a logical OR function sum of the output signal of the from XNOR 411 and the output signal of the from AND gate 413. The output of OR gate 408 is applied to the reset terminal R of the 2-bit counter 401.

[0083] FIG. 6A, 6B, and 7 are timing charts diagrams showing of a function of the operation check function control circuit 310 explained above.

[0084] First, the state when the operation check function mode is not at the other than mode 2, the operation check function mode select result signal SV2 has the is at a low level, and the operation check function control signal SS which is at a has the low level will be described.

[0085] In this case, the operation check function control circuit 310 receives the signal SR1 having the which is at a high level for more than 1 or 2 seconds (period T1) of time, and from the time the signal SR1 turns to the is set to a low level, when the signal SR1 falls twice continuously from the a high level to the a low level at an interval T2, namely of less than an average of 1.5 second average, raises sets the operation check function control signal SS to the a high level.

[0086] This operation is described by with reference to FIGs. 6A and 6B.

[0087] At the initial state, the output signal Q of the SR latch 406 ~~has the~~ is at high level, both the output signals Q0 and Q1 of the counter 402 ~~have the~~ are at a low level, the signal SS ~~has the~~ is at a low level, the output signal of the ~~doubled~~ dual-input XNOR gate 411 ~~has the~~ is at a high level, both the output signals Q0 and Q1 of the counter 401 ~~have the~~ are at a low level, and the output signal Q of the D flip-flapflip-flop 405 ~~has the~~ is at a low level.

[0088] ~~Here, when~~ When the crown is pulled out to the second click, the signal SR1 ~~becomes the~~ is set to a high level. As a result, the output signal of the AND gate 412 ~~becomes the~~ is set to a high level, and the reset of the counter 403 and the D flip-flapflip-flop 404 are cancelled.

[0089] After this cancellation, when the first clock pulse F1 is generated, ~~by this clock pulse F1 counting of the counter 403 is carried out~~ counts this clock pulse F1, and ~~the~~ causing its output signal XQ of the counter 403 ~~to~~ falls (the arrow a1).

[0090] ~~Then, w~~ When the second clock pulse F1 is generated, ~~counting of the counter 403 is carried out further~~ counts this pulse, and ~~the~~ its output signal XQ of the counter 403 ~~rises~~ (the arrow a1). As a result, ~~the~~ a high level signal is input to ~~the~~ the clock in put of D flip-flop 404, and ~~the~~ output signal Q of the D flip-flop 404 rises (the arrow a3). Then due to by this rise of in the output signal Q of the D flip-flop 404, the SR latch 406 is reset, and the output signal Q of the SR latch 406 ~~becomes the~~ is reset to a low level (the arrow a4). ~~And b~~ Because the output of SR latch 406 becomes the is reset to a low level, the reset state of the counter 402 is cancelled, and ~~the state of the counter 402~~ enters a state where it can actively count ~~becomes practicable to counting.~~

[0091] Next, when the crown is pushed back from the second click to the first click or to the normal position, the signal SR1 falls to ~~the~~ a low level. As a result, the counter 403 and the D flip-flapflip-flop 404 are reset, and ~~the~~ output signal Q of the D flip-flapflip-flop 404 ~~becomes the~~ is set to a low level.

[0092] On the other hand, when the pulse signal SR2 is generated by the fall of the signal SR1, the pulse signal SR2 starts the counter 402 ~~to conduct the counting up,~~ and the output signal Q0 of the counter 402 rises to ~~the~~ a high level (the arrow a6). As a result, the output signal of the XNOR gate 411 ~~becomes the~~ is set to a low level (the arrow a7). Thus the reset state of the counter 401 is cancelled, and ~~the state of the counter 401 becomes practicable to counting~~ is set to an active counting state, i.e. a state where it can actively count.

[0093] As described above, after the crown is pulled out to the second click, when two clock pulses F1 are generated, ~~the state of the counter 402~~ is set to its active

~~counting state becomes practicable to counting.~~ Then when the crown is pushed back to the first click or to the normal position, the state of the counter 401 ~~becomes practicable to~~ is set to its active counting state.

[0094] In the above description, in the period from the rise to the fall of the signal SR1, two clock pulses F1 are generated. However, a case where three or more clock pulses F1 are generated ~~falls into the same~~ has a similar result.

[0095] Afterward, if the crown is not ~~handled~~ adjusted, the signal SR1 does not change, and the clock pulse F1 is generated, ~~then counting up is carried out at the counter 401 will continue to count, and the its output signal Q0 of the counter 401 becomes the~~ will be set to a high level (the arrow a8). Then ~~when the~~ if another clock pulse F1 is generated ~~further, counting up is carried out at the it will be counted by counter 401, and the resulting in output signal Q0 of the counter 401 becomes the being set to a low level, and the output signal Q1 of the counter 401 becomes the being set to a high level (the arrow a9).~~

[0096] Then because the output signal Q1 of the counter 401 ~~becomes the~~ is set to a high level, the output signal Q of the SR latch 406 ~~become the~~ is set to a high level (the arrow a10). As a result, the counter 402 is reset, the output signal Q0 of the counter 402 ~~becomes the~~ is set to a low level (the arrow a11), and the output signal of the XNOR gate 411 ~~becomes the~~ is set to a high level (the arrow a12).

[0097] Then because the output signal of the XNOR gate 411 ~~becomes the~~ is set to a high level, the counter 401 is reset (the arrow a13); and afterward the counter will not count even if the clock pulse F1 is ~~given~~ generated.

[0098] As described, even when the counters 401 and 402 ~~become practicable to counting are set to their active counting state~~ by pulling the crown to the second click and pushing it back to the original position, if the crown is not ~~handled~~ adjusted, the operation check function control circuit 310 returns to the state before ~~handling adjusting~~ the crown, and the signal SS does not change.

[0099] ~~Compared to this~~ In comparison, when the counters 401 and 402 ~~become practicable to counting are set to their active counting state~~ by pulling the crown to the second click, if a prescribed crown ~~handling is done~~ adjusting is carried out, the signal SS is raised by the operation check function control circuit 310.

[0100] ~~From here, FIG. 6B is~~ will now be described. The ~~Operations with the relating to arrows a1 to a7~~ are the same as ~~in those described with reference to FIG. 6A.~~

[0101] As described in FIG. 6A, after the crown is pulled out to the second click, when two clock pulses F1 are generated, the state of the counter 402 is placed in its

~~active counting state becomes practicable to counting.~~ Then when the crown is pushed back to the first click or to the normal position, ~~the state of the counter 401 becomes practicable to~~ is placed in its active counting state (the arrows a1 to a7).

[0102] Afterward, if the clock pulse F1 is generated, ~~counting up at the counter 401 is carried out by this clock pulse F1 is counted by counter 401,~~ and the numbercount value of count of the counter 401 becomes "1" (the arrow a11). ~~But However, before the next clock pulse F1 is generated,~~ if the pulse SR2 is generated by the handling of adjusting the crown before the next clock pulse F1 is generated, the counter 401 ~~is will be reset;~~ and ~~the its count value number of count of the counter 401 will~~ becomes "0" (the arrow a12). ~~And counting up at the eCounter 402 is carried out by the counts pulse SR2,~~ and the numbercount value of count of the counter 402 will becomes "2" (the arrow a13).

[0103] ~~Then w~~When the clock pulse F1 is again generated, ~~it will be counted counting up at the by counter 401,~~ whose ~~is carried out by this clock pulse F1,~~ and the numbercount value of count of the counter 401 will becomes "1" (the arrow a14). ~~But before the next clock pulse F1 is generated,~~ if the pulse SR2 is generated by the handling of adjusting the crown before the next clock pulse F1 is generated, the counter 401 ~~is will be reset;~~ and ~~the number of count of the counter 401 its count value will~~ becomes "0" (the arrow a15). Also, And counting up at the counter 402 is ~~carried out by the will count pulse SR2,~~ and ~~the its numbercount value of count of the counter 402 will~~ becomes "3" (the arrow a13). As a result, ~~the signal SS becomes will be set to a the-high level (the arrow a17).~~ By this, the operation mode of the ~~electrical electric~~ timepiece ~~becomes the is set to mode 1,~~ ~~And and the reset state at the of D flip-flapflip-flop 405,~~ the reset is cancelled.

[0104] When the numbercount value of count of the counter 402 becomes "3", the output signal of the XNOR gate 411 ~~becomes the is set to a high level (the arrow a18).~~ As a result, the counter 401 is reset. Therefore, afterward if the further generations of clock pulse F1 is generated, ~~counting operation at the will not be counted by counter 401 until it is set active again will not be carried out.~~

[0105] As described above and shown in Fig. 6B, three conditions are required to set signal SS to a high level. Firstly, if in during the a period from the rise to the fall of the signal SR1, two or more clock pulses F1 are generated, after Secondly, another the rise and fall pulse of the signal SR1 is generated followed by another F1 pulse. and Thirdly before the generation of ~~the a subsequent clock pulse F1,~~ the another rise and fall pulse of the signal SR1 (the pulse SR2) takes place, and before the generation of the next clock pulse F1, the fall of the signal SR1 (the pulse SR2) takes place, the by which signal SS is switched set to the a high level. Here,

because the ~~cycle period of the clock pulse F1~~ is one second, the time period from the rise of the signal SR1 to the fall of the signal SR1, or the time period T1 in FIG. 7, will be fully ~~satisfied complete~~ within two seconds.

[0106] The time period from the first fall to the second fall of the signal SR1, or the time period from the third fall to the fourth fall of the signal SR1, or the time period T2 in FIG. 7, will be ~~satisfied completed~~ within 1.5 seconds.

[0107] Next, the state when the operation check function mode select result signal SV2 ~~has the~~ is at a low level, and the operation check function control signal SS ~~has the~~ is at a high level will be described.

[0108] In this case, when the signal SR1 rises, the mode 1 is cancelled. This operation is described in reference to in FIG. 6B.

[0109] First, when the signal SR1 rises, ~~the a~~ high level signal is input to the D flip-flop 405, and the output signal Q of the D flip-flop 405 becomes ~~the is~~ set to a high level (~~the~~ arrow a21). As a result, ~~the~~ SR latch 406 is set (~~the~~ arrow a22), output a high signal at its output and thereby this the placing counter 402 is in a reset state. As a result, ~~and the numbercount value of count of the counter 102 becomes "0" (the arrow a23).~~ Then because ~~the counter 402 is in its reset state,~~ the signal SS ~~becomes the is~~ set to a low level, and the mode 1 is cancelled (~~the~~ arrow a24).

[0110] ~~And because the~~ Since signal SS ~~becomes the is~~ at a low level, ~~the D flip-flop~~ flip-flop 405 is reset (~~the~~ arrow a25). The subsequent operation after this differs depending depends on what kind of the wave form is formed by the of signal SR1, but ~~and~~ is described already above.

[0111] Next, reference to FIGS. 4 and 7, the state when the operation check function mode is ~~at the to~~ mode 2, and the operation check function mode select result signal SV2 ~~becomes the is~~ at a high level will be described.

[0112] In this case, even if the signals SR1 and SR2 changes, the operation check function control signal SS ~~does not turn to the is not~~ set to a low level.

[0113] Next, referring with reference to FIG. 5 ~~the a~~ detailed description will be given with respect to the second external input unit measure circuit 311, the operation check function mode select circuit 312, the stored electricity unit discharge control circuit 305, the stored electricity unit charging completion judge circuit 306, and the motor drive trouble judge circuit 304.

[0114] The second external input unit measure circuit 311 comprises an inverter 501, a ~~double~~ dual-input AND gate 502, and a 2-bit counter 503. The inverter 501

receives the operation check function control signal SS. The AND gate 502 receives the second external input signal ST and the operation check function mode select result signal SV3. Here, the second external input signal ST is a signal which becomes the that is set to a high level when the switch (indicator switch) of the second external input unit G is pushed back. The output of inverter 501 is applied to the reset input of As for the 2-bit counter 503, in the reset terminal R enters an output signal of the inverter 501, and the output of AND gate 502 is applied to in the clock input of the 2-bit counter 503terminal enters an output signal of the AND 502. Therefore, when the both signals SS has the high level and the signal and SV3 has the are at a high level, the 2-bit counter 503 is placed in its active counting state and counts the number of pulses (the number how many times the indicator switch is pushed back)input as the of second external input signal ST (i.e. the number of many times the indicator switch is pushed back). Here, the sSignal SV3 is a signal generated by decoding the output of the counter 503, and it is set becomes the to a low level when the numbercount value of count of the counter 503 is 2. Therefore, the counter 503 counts the value from 0 to 2.

[0115] In an explanatory example of FIG. 7, after the operation check function control signal SS becomes the is set to a high level at the time t1, the bits-bit signals SU1 (Q0) and SU2 at respective outputs (Q0 and Q1) of the counter 503 has been the are set at low levels. At the time t2, as the signal ST, a pulse signal is input to the counter 503, the bit SU1 of the counter 503 becomes the is set to a high level and the bit SU2 of the counter 503 becomes the is set to a low level. At the time t3, as the signal ST, another pulse signal is input to the counter 503, the bit SU1 of the counter 503 becomes the low level and the bit SU2 of the counter 503 becomes the are set to a high level. When the bit SU1 becomes the is set to a low level and the bit SU2 becomes the is set to a high level, the signal SV3 becomes is set to a low level. In this case, for example, even if, as the signal ST, a pulse signal is input to the counter 503, the output value of the counter 503 does not change. The counter 503 is reset when the signal SS becomes the is set to a low level (at the time t5).

[0116] The operation check function mode select circuit 312 in FIG. 5 comprises an 3-input AND gate 504 (having three input of two negative logic active low inputs and one positive logic active high input), an 3-input NAND 506 (having three input of one negative logic active low inputs and two positive logic active high inputs). Bits SU1 and SU2 of counter 503 are applied to the In two negative logic active low inputs of the AND gate 504 enter bits SU1 and SU2 of the counter 503, and the operation check function control signal SS in one positive logic is applied to the active high input of the AND gate 504 enters the operation check function control signal SS. As shown in FIG. 7, when both the bits SU1 and SU2 of the counter 503

~~has the are~~ at a low level and the operation check function control signal SS ~~has the~~ is at a high level, the AND gate 504 outputs the operation check function mode select result signal SV1 ~~with the~~ at a high level indicating the operation check function is at the mode 1. In the same way, when the bit SU2 of the counter 503 ~~has the~~ is at a low level and both the bit SU1 and the operation check function control signal SS ~~has the are~~ at a high level, the AND gate 505 outputs the operation check function mode select result signal SV2 ~~with the~~ at a high level indicating the operation check function is at the mode 2. When the bit SU1 of the counter 503 ~~has the~~ is at a low level and both the bit SU2 and the operation check function control signal SS ~~has the are~~ at a high level, the NAND gate 506 outputs the operation check function mode select result signal SV3 ~~with the~~ at a high level indicating the operation check function is at the mode 3.

[0117] The stored electricity unit discharge control circuit 305 comprises an inverter 507, a D flip-flop 508, a ~~double~~dual-input AND gate 509, and a ~~triple~~3-input AND gate 510.

[0118] ~~In the inverter 507 enters a~~ Voltage detect result signal SN1 is input to inverter 507. ~~The s~~Signal SN1 ~~is one of~~ comes from one the bit lines of the voltage detect result signal SN. The signal SN1 ~~becomes the~~ is set to a high level, when the detection ~~is made it is detected~~ that the signal SC of indicating the stored voltage VKTN becomes lower than the discharge reference voltage DCHRGV (further from the ground VDD, that is, not reaching the predetermined discharge voltage). ~~Incidentally~~It is to be noted, instead of the above configuration, it is also possible to ~~make set~~ the signal SN1 ~~the to~~ a high level, when the detection ~~is made it is detected~~ that the stored voltage raising and lowering result signal SD which indicates the output voltage VSS of the raising and lowering circuit 49 becomes lower than the discharge reference voltage DCHRGV.

[0119] ~~As for Regarding the~~ D flip-flop 508, the operation check function mode select result signal SV1 is input to the reset terminal R ~~having the low active~~ enters the operation check function mode select result signal SV1, and the output signal of inverter 507 is input to in the clock terminal CLK ~~enters the output signal of the inverter 507~~, and the data input terminal D is fixed at ~~the a~~ high level.

[0120] The AND gate 509 ~~outputs a logical product~~ outputs the logic AND function of the output signals of the output terminal XQ of the D flip-flop 508 and the operation check function mode select result signal SV1 as the first stored electricity unit discharge control signals SO1.

[0121] The AND gate 510 ~~comprises a negative logic~~ has an active low input and two positive logic active high inputs. ~~Into the negative logic input enters t~~The first

stored electricity unit discharge control signals SO1 from the AND gate 509 is applied to the active low input of AND gate 510. Into the positive logic inputs enters the operation check function mode select result signal SV1 and the discharge reference voltage DCHRGV are applied to the active high inputs of AND gate 510. The AND gate 510 outputs a the logical AND function product of the its input signals as the second stored electricity unit discharge control signals SO2.

[0122] As shown in FIG. 7, the stored electricity unit discharge control circuit 305 makes-sets the first stored electricity unit discharge control signals SO1 the to a high level when operation check function mode shifts to the mode 1 under the condition when the battery unit (battery 48) is being charged.

[0123] In a period P1 when the first stored electricity unit discharge control signals SO1 has the are at a high level, the timepiece control circuit 303 in FIG. 3 outputs as the motor driving signal SF a drive clock signal which short-circuits the motor drive circuit E or fast-forwards the motor unit D. Accordingly, in during the period P1 in FIG. 7, the electrical electric charge in the battery unit 48 is released to be as a drive current on a scale much larger higher than that at of the normal drive state in of the motor unit D.

[0124] As discharging continues, when the stored electricity voltage VTKN or the stored electricity voltage raising and lowering result voltage VSS becomes higher than the discharge reference voltage DCHRGV (that is, nearer to the ground VDD, meaning the discharging advanced operation is progressing), the signal SN1 becomes the is set to a low level synchronous to with the voltage detect control signal SX, which is repeatedly becomes the set to a low level in a predetermined cycle. When the signal SN1 becomes the set to a low level, the stored electricity unit discharge control circuit 305 makes-sets the first stored electricity unit discharge control signals SO1 the to a low level. By this Thus, the period P1 shifts to a period P2.

[0125] When the first stored electricity unit discharge control signals SO1 becomes the are set to a low level, the timepiece control circuit 303 in FIG. 3 outputs for example a signal to stop the motor drive unit E. Accordingly, in the during period P2, discharging of the battery unit 48 is stopped, and the stored electricity voltage VTKN or the stored electricity voltage raising and lowering result voltage VSS becomes to the is gradually brought to a low voltage gradually by the voltage recovery effect. Then when the voltage VTKN or VSS becomes lower than the discharge reference voltage DCHRGV, the signal SN1 becomes the is set to a high level synchronous to with the voltage detect control signal SX, and the second stored

electricity unit discharge control signals SO2 ~~becomes the~~ is set to a low level. By this, the period P2 shifts to a period P3.

[0126] ~~Incidentally~~ It is to be noted that, although not shown in FIG. 3, the operation check function control signal SS and the operation check function mode select result signal SV and the like are supplied to the timepiece control circuit 303. The timepiece control circuit 303 is capable of distinguishing the shifting state between each mode by these control signals.

[0127] When the second stored electricity unit discharge control signals SO2 ~~becomes the~~ are set to a high level, the timepiece control circuit 303 in FIG. 3 outputs, as the motor driving signal SF, a drive clock signal to fast-forward the motor unit D. Here, ~~as fast-forwarding modes, include there are a~~ 32 hertz fast-forwarding, an intermittent drive of 32 hertz drive and stop, ~~and~~ 8 hertz fast-forwarding, and the like. ~~In a period~~ During P3, the ~~electrical~~ electric charge of the battery unit 48 is re-released to be a drive current on a scale of smaller than that of the period P1 and larger than that at the normal drive state.

[0128] Then, when the voltage VTKN or VSS again becomes higher than the discharge reference voltage DCHRGV ~~again, the signal SN1 becomes the~~ is set to a low level at the ~~a timing synchronous to with~~ the voltage detect control signal SX, and the second stored electricity unit discharge control signals SO2 ~~becomes the~~ are set to a low level. ~~By this~~ Thus, the period P3 shifts to a period P4.

[0129] When the second stored electricity unit discharge control signals SO2 ~~has the~~ are at a low level, the timepiece control circuit 303 stops the motor drive circuit E. Therefore, ~~in the~~ during period P4, discharging of the battery unit 48 is stopped, and the stored electricity voltage VTKN of the battery unit 48 or the stored electricity voltage raising and lowering result voltage VSS is again gradually brought becomes to the low voltage gradually by the voltage recovery effect again. Until the stored voltage becomes stable or the shift to the mode 2 is carried out by the external input, the ~~states~~ operations performed during of the periods P3 and P4 ~~is are~~ repeated and the discharging is carried out. However, in the example of ~~But~~ FIG. 7, ~~shows an example that after one repeat operation the~~ a shift to the mode 2 is conducted.

[0130] Next, the stored electricity unit charging completion judge circuit 306 shown in FIG. 5 will be described. The circuit 306 is composed of an AND gate 511, and outputs as the stored electricity unit charge completion control signal SP a logical ~~product~~ AND function of the voltage detect result signal SN2 and the operation check function mode select result signal SV2. Here, the signal SN2 is a signal output from the voltage detecting circuit 302 ~~and becomes the~~ and is set to a

high level when the stored electricity voltage VTKN or the stored voltage raising and lowering result signal SD (VSS) becomes lower than the charge reference voltage CHRGV (that is, further from the ground VDD, or reaching the predetermined discharge voltage). The signal SV2 is a signal output from the operation check function mode select circuit 312 and ~~becomes the~~ is set to a high level when the mode is 2. Accordingly, the signal SP becomes ~~the~~ is set to a high level when the operation check function is at mode 2 and the stored electricity unit 48 is charged until ~~the~~ it reaches charge reference voltage CHRGV.

[0131] In ~~the~~ mode 2 in the timing chart of FIG. 7, a vibration is given to the timepiece from outside, and electricity is generated in the generator system A. Therefore ~~the charging to of the~~ battery unit 48 is conducted, and the stored electricity voltage VTKN ~~is going~~ goes down (period P5). During this time, the timepiece control circuit 303 supplies for example a prefixed pulse signal to the motor ~~dive~~ drive circuit E, and ~~controls~~ causes the motor unit D to ~~the~~ perform normal hand movement (one-second interval movement).

[0132] Charging continues, and when the stored electricity voltage VTKN or the stored voltage raising and lowering result voltage signal SD (VSS) becomes lower than the charge reference voltage CHRGV, the signal SN2 ~~becomes the~~ is set to a high level synchronous ~~to~~ with the voltage detect control signal SX. And Additionally, the stored electricity unit charge completion control signal SP ~~becomes the~~ is set to a high level. ~~By this~~ Thus, the period P5 shifts to a period P6.

[0133] When the stored electricity unit charge completion control signal SP ~~becomes the~~ is set to a high level and the stage operation enters into the period P6, the timepiece control circuit 303 supplies, for example, the motor driving signal SG to the motor dive circuit E, and controls the hand movement state of the motor unit D to for example two-second interval movement which is different from the normal hand movement (in this case, one-second interval movement). By this change of the hand movement state operation, the notification of the completion of the charging is ~~made~~ provided. ~~Incidentally~~ It is to be noted that, in the period P6, if the charging voltage increases (that is, discharging is conducted), charging is conducted in the same way as ~~the~~ in period P5. Accordingly, ~~in practical practice,~~ the periods P5 and P6 ~~is are~~ are repeated, and the charging voltage becomes stable.

[0134] Next, the motor drive trouble judge circuit 304 shown in FIG.5 will be described. ~~The~~ Circuit 304 comprises ~~doubled~~ dual-input AND gates 512 and 513, (both having a ~~positive logic~~ one active-high input and a ~~negative logic~~ active-low input), a triple-input OR gate 514, a ~~doubled~~ dual-input OR gate 515, and a 3-bit counter 516.

[0135] ~~The AND gate 512 receives the non-rotation detect measure signal SY as a positive logic at its active-high input terminal, and the high-frequency magnetic field detect result signal SK or the alternating current magnetic field detect result signal SL as a negative logic at its active-low input terminal.~~ Here, the signal SY is a signal generated when the non-rotation in the motor unit D is detected. The signals SK and SL ~~becomes the~~ are set at high levels when a magnetic field is detected.

[0136] ~~The AND gate 512 receives the rotation detect result signal SM as at its active-low positive logic input terminal, and receives an output bit Q2 of the counter 516 as a negative logic at its active-low input terminal.~~ Here, the signal SM ~~becomes the~~ is set to a high level when the non-rotation in the motor unit D is detected. The output bit Q2 of the counter 516 ~~becomes the~~ is set to a high level when the counter number of the counter 516 becomes 4 or more.

[0137] ~~The OR gate 514 receives the output signal of the AND gate 512, the operation check function mode select result signal SV3, and the output bit Q2 of the counter 512.~~

[0138] ~~The OR gate 515 receives the output signal of the AND gate 513 and the operation check function mode select result signal SV3.~~

[0139] The operation of the motor drive trouble judge circuit 304 configured as explained above will be described by reference to FIG. 7 as follows.

[0140] In FIG. 7, ~~at the~~ in mode 2, when the indicator switch is pushed on, operation shifts to the mode 3 ~~is carried out~~ (the period P6 to period P7). In this mode ~~4~~ 3, the operation check function mode select result signal SV3 ~~becomes the~~ is set to an active level (low level), and the reset state of the counter 516 of the motor drive trouble judge circuit 304 is cancelled.

[0141] ~~At the~~ In mode 3, the quality verification of the operation state under high and low temperatures condition ~~is~~ carried out. ~~The~~ Quality verification is carried out as follows.

[0142] First, the timepiece control circuit 303 in FIG. 3 supplies the motor drive signal SE to the motor drive circuit E, and conducts a normal control of the motor unit D (one-second interval movement, rotation detect, drive by auxiliary pulse under a certain condition, and the like).

[0143] Here, this supply of the motor drive signal SE ~~rotates~~ causes the motor to rotate. And when the rotation is detected, the rotation detect result signal SM is output from the rotation detect circuit 309, and thus the counter 516 is reset.

[0144] On the other hand, if the motor does not rotate ~~with the supply of the~~ when signal SE is supplied, pulse signals including the auxiliary pulse having ~~bigger effective electric more~~ power than the normal driving pulse are automatically supplied to the motor drive unit D from the timepiece control circuit 303, and at the same time the timepiece control circuit 303 outputs the non-rotation detect measure signal SY.

[0145] ~~The e~~Counter 516 counts the number of ~~generation times of the~~ signal SY is generated.

[0146] When the non-rotation detect measure signal SY ~~enters into the~~ is applied to counter 516 four times successively while under a condition of no detection of no rotation is detected, ~~the output bit Q2 of the counter 516 becomes the~~ is set to a high level, and the motor drive trouble judge signal SQ indicating that the motor has a problem is output.

[0147] The timepiece control circuit 303, when the motor drive trouble judge signal SQ ~~becomes the~~ is at a high level, supplies to the motor drive circuit E, for example, the motor drive signal SH for ~~controlling causing~~ the motor unit D to implement two-second-interval hand movement which is different from the normal hand movement of one-second-interval hand movement.

[0148] On the other hand, when the motor drive trouble judge signal SQ ~~becomes the~~ is set to a high level, the counter 516 no longer receives a reset signal and a clock signal. Therefore, the counter 516 stops counting. The signal SQ maintains ~~the a high level until the mode 3 is cancelled and the operation check function mode select result signal SV3 becomes the~~ is set to a high level.

[0149] ~~Namely~~ Specifically, even after the quality verification operation ~~under at~~ high and low temperatures ends, and the temperature becomes normal temperature, as long as ~~the mode 3 is maintained, drive signals causing a having different hand movement state different~~ from the normal hand movement is supplied to the motor unit D.

[0150] Accordingly, after the quality verification operation, notification of the motor drive trouble that occurred during the quality verification operation continues to be made.

[0151] Next, the motor driving signal SF for discharging the battery unit will be described by reference to FIG. 8.

[0152] FIG. 8 is a block diagram showing the timepiece control circuit 303 shown in FIG. 1, the motor drive circuit E and the motor unit D. The motor drive circuit E comprises switches 701 to 705 and 707, and rotation detect use elements 706 and

708. In the example shown in FIG. 8, switches 701, 703, 705, and 707 are P-channel MOS (metal oxide semiconductor) transistors, and switches 702 and 704 are N-channel MOS transistors.

[0153] Four switches 701 to 704 form a bridge circuit which drives the stator winding of the motor unit D by use of a potential difference between VDD and VSS as source voltage.

[0154] Rotation detect use elements 706 and 708 are elements to place restrictions on current flowing through the motor unit D, and are comprised of resistors and the like.

[0155] Switch 705 and rotation detect use element 706 are connected in series between one terminal of the motor coil of the motor unit D and the power source line VDD. Switch 707 and rotation detect use element 708 are connected in series between the other terminal of the motor coil of the motor unit D and the power source line VDD

[0156] ~~By the above configuration, in order to~~ To make cause short-circuit current to flow in the motor drive circuit E (for the purpose of discharging the battery unit 48) using the above configuration, by turning the switches 701 and 704 are turned on, it is possible to make the cause short-circuit current O1 to flow in accord with the load of the motor unit D. By turning on the switches 701-703 and 702-704 on, it is also possible to make cause the short-circuit current O2 to flow in accord with the load of the motor unit D. And by making one of short-circuit currents O1 or O2 flow constantly, or by making short-circuit currents O1 and O2 flow by turns at a predetermined fast-forwarding cycle, it is possible to control the short-circuit current.

[0157] When required to generate a comparatively small discharge current, it is possible to ~~make establish~~ discharge current flow to the through motor unit D via ~~the rotation detect use elements 706 or 708.~~

[0158] Next, one example of the operation check method of the electronic timepiece explained above will be described by reference to FIG. 9A, 9B, 9C, and 10. FIGs. 9A, 9B, and 9C ~~cooperate to collectively~~ form a flowchart showing flow of operation check process of the electronic timepiece. The flowchart shows the check procedure of processes B101, B104, and B105, which comprise the operation check process B100 shown in the FIG. 2. FIG. 10 shows a specification of the operation check process in FIGs. 9A, 9B, and 9C.

[0159] With Reference to FIGs. 9A, 9B, and 9C, when the timepiece is under in the normal operation drive state (in step 801), and is shifted to mode 1 by specific

operation of the crown in step 802 (i.e. operation for commanding to a shift to the mode 1 is commanded, as shown in FIG. 10, that is to by pulling out the crown by two clicks and pushing it back for a predetermined time period), is done (step 802). As a result, the mode 1 (battery discharge mode) starts. Here, discharging by In mode 1, the drive is discharged by using, for example, a fast-forwarding pulse with of 32 hertz (step 803). By Due to this discharging, when the absolute value of the stored voltage VTKN declines falls below a prefixed predetermined voltage (in FIG. 10, i.e. 1.25V in Fig. 10), the drive in the motor unit D is stoppeds (step 804). In practicalpractice, the fast-forwarding drive discharging operation in step 803 has two steps: of the first being the a continuous fast-forwarding discharging; and the second being a discharging by repeateding stopping and starting of the fast-forwarding discharge and stoppage by turn at a at two second-eyele intervals. And when If the voltage of the battery 48 returns drifts upward, the steps 803 and 804 are carried out again and then repeatedly until the voltage will not return no longer drifts. It will take for example several tens of hours discharging until the discharged state becomes stable at the state of the step 804. IncidentallyIt is to be noted that, the time period necessary to discharge differs depending on the type of battery, as shown in FIG. 10, but several tens of hours is adequate. Therefore after discharging for a predetermined time period of several tens of hours, by checking the hand movement state, it is possible to judge-determine whether or not the discharging operation is completed. In this example, as shown in FIG. 10, when repeatedly fast-forwarding and stoppage-stopping is occurring, it is possible to judge determine that the discharging operation is completed, and when continuously fast-forwarding is occurring, it is possible to judge-determine that the discharging operation is not completed.

[0160] After completion of the discharge, when the operator handles the indicator switch once (step 805), the mode shifts to the mode 2 (charging mode). In the mode 2, the motor unit D is driven (step 806) in-using the normal hand movement method (one-second interval movement). During this period, by giving-applying vibration, electricity is generated in the generator system A, and the battery 48 is charged (step 807). In-here this step, charging for from several tens of minutes to several hours is carried out, and when the absolute value of the stored voltage VTKN becomes equal to or larger than the a predetermined voltage (in FIG. 10, 1.33 V), the normal hand movement state shifts to the two-second interval movement state (step 808). Therefore, after the predetermined time period, if the normal hand movement state is maintained, it is possible to judge-determine that the charging function has a problem (step 809). In-here this step, before the operation check of the mode 3, time adjusting is carried out (step 810). Time adjusting is done

accomplished by, for example, pulling out the crown by two clicks and turning the crown. In the present embodiment, when the mode is at the mode 1 or 3, if the crown is operated, the operation check function is released. But, when the mode is at the mode 2, if the crown is operated ~~for~~ to adjusting time, the mode does not shift to another mode.

[0161] Next, when the operator handles the indicator switch once (step 811), the mode shifts to the mode 3 (operation mode). In the mode 3, the motor unit D is driven (step 812) ~~in-using~~ the normal hand movement. Then in the electronic timepiece, self-verification of the drive malfunction during operation is carried out by use of the auxiliary pulse (step 813). ~~In-here~~ this step, when the successive pulse drive does not require the use of ~~by using~~ more than a predetermined number of auxiliary pulses ~~is not carried out during operation~~, the electronic timepiece judges determines itself ~~as to be~~ normal and leaves the hand movement state in the one-second-interval movement (step 814). ~~By this~~ Thus, the operator can judge determine that the electronic timepiece is in good quality. On the other hand, when the successive pulse drive requires the use of ~~by using~~ more than a predetermined number of auxiliary pulses ~~is carried out during operation~~, the electronic timepiece judges determines itself ~~as to be~~ bad and ~~makes places~~ the hand movement state in the two-second-interval movement (step 815). ~~By this~~ Thus, the operator can judge determine that the electronic timepiece is ~~in bad quality~~.

[0162] Next, when the operator performs a two-click crown pull-out (step 816), the mode 3 is cancelled, and ~~the normal operation state is recovered~~ restarted (step 817).

[0163] ~~Incidentally~~ It is to be noted that, ~~at the in~~ in step 814, when the indicator handling is ~~carried out executed~~ twice (step 818), the movement ~~becomes~~ is placed ~~in the one-second-interval movement operation~~ (step 819). In this case, even if the charging is carried out next (step 820), the one-second hand movement continues (step 821) irrespective of the charging state. And ~~at the in~~ in step 804, when the indicator handling is carried out three ~~times or more~~ times (step 822), the indicator for indicating the charging state is put into operation (step 823). ~~And a~~ Also, ~~at the in~~ in step 810, it is conceivable that indicator handling is carried out twice or more times (step 824), or the operation state becomes that of ~~the step~~ 821 or 823. In these cases, when the crown is next ~~handled once next time~~ (step 825), the operation returns to the normal drive state of ~~the step~~ 801. By these check procedures, even if the operator makes a mistake in inputting an operation with the indicator, it is impossible to ~~happen mis-judgement of the~~ identify a poor quality product as a good quality one. For example, ~~at the in~~ in step 804, ~~the normally check~~

~~flow is first at the indicator is handled once then shifting to shift to the mode 2.~~ However, it can happen that the operator ~~performs handles the~~ indicator handling twice by mistake. In this case, one-second interval movement takes place, ~~And~~ and the operator cannot tell ~~whether that the~~ movement is ~~of the that of~~ step 806 or step 819. ~~But However,~~ since the operator thinks that the indicator handling ~~is was~~ performed once, the operator thinks the mode is ~~at the mode 2~~ and conducts charging. In this case, charging ~~at the in~~ step 820 ~~follows is executed followed by~~ and then one-second interval movement ~~at the in~~ step 821 follows. ~~And Since~~ the operator ~~mistakes thinks the step 809 for~~ step 821 ~~as the step 809,~~ and the operator ~~determines judges that the~~ electronic timepiece ~~to be in poor condition is bad~~ (in reality, since at the mode 1 the indicator is handled twice, the mode ~~is was~~ shifted to the mode 3, ~~and~~ not to mode 2). As ~~described explained~~ here, there are ~~eases~~ circumstances ~~when that the~~ check flow shifts to the step 825 due to mis-judgement of the ~~a good quality product being misjudged as a poor quality one.~~ But it is impossible to ~~mis-judge misjudge the a poor quality product as a good quality one.~~ ~~And Furthermore, the a mis-judged good timepiece as that is misjudged as bad poor quality is will undoubtedly re-judged as good when the check routine is redone repeated starting from the step 825.~~ ~~And Additionally at the step 804, when if the~~ indicator handling ~~is handled is performed~~ three times or more, ~~that is as in the~~ above case when the operator ~~performs handled the~~ indicator handling ~~three two~~ times ~~or more~~ by mistake, the third indicator handling ~~of the indicator is signals,~~ for example, an operation for starting ~~the displaying of the~~ charging amount indicator. Since ~~In in~~ this check operation flow, ~~since there is no process step to for starting the displaying of the~~ charging amount indicator, the operator can tell immediately that the mode is not at the mode 2 due to ~~the~~ difference of the display. Therefore, the operator ~~thinks recognizes~~ that the indicator ~~was mishandleding is wrongly done,~~ and proceeds to the step 825, ~~then reconducts and re-executes the~~ checking operation flow. ~~On the other hand Furthermore, if the process flow is at the step 810, and if the indicator handling is performed is handled twice two times or more,~~ the second ~~handling of the indicator handling is would typically signal~~ an operation for starting ~~the displaying of the~~ charging amount indicator. ~~However In in~~ this check flow, ~~since there is no process to start the displaying of the~~ charging amount indicator, ~~and the operator can therefore tell immediately recognize~~ that the mode is not at the mode 3 due to ~~the~~ difference of the display. Therefore, the operator ~~thinks recognizes~~ that the indicator ~~was mishandleding is wrongly done,~~ and proceeds to the step 825, ~~then and re-conducts re-executes the~~ checking flow.

[0164] As described above, with ~~in~~ the present embodiment, ~~at the in~~ mode 1, by ~~performing applying~~ an external input operation to the electronic timepiece,

discharging is ~~carried out~~ implemented by fast-forwarding drive in the motor unit D, or by short-circuiting of the motor drive circuit E, or the like. Accordingly, no special provision for discharging the battery is necessary. ~~And~~ Additionally, when the operational mode becomes the shifts to mode 1, the shift takes place from the normal hand movement state to the different state of fast-forwarding hand movement or hand movement stoppage. By ~~looking~~ observing the difference of the in hand movement, the mode shift is easily verified.

[0165] In the above embodiment, the external input operation is performed by use of the crown and the indicator switch. But the present invention is not limited to this. It is possible to use other mechanical input methods. ~~And it~~ It is also possible to ~~furnish~~ provide an infrared remote control receiver unit in the electronic timepiece, and use infrared signaling as the input method. Electricity, a radio wave, light, sound, an electromagnetic wave, heat, and the like are also applicable suitable as input methods.

[0166] In the above embodiment, discharging ~~at the in~~ in mode 1 is continued until the battery voltage reaches the prescribed voltage. ~~And w~~ When the battery voltage reaches the prescribed voltage, the discharging and the hand movement stop. Accordingly, by the hand movement (fast-forwarding or stoppage), ~~judging it~~ it is possible to determine whether discharging ~~continues is ongoing~~ or discharging is completed. ~~And Also, by the battery voltage recovery effect when the battery voltage drifts exceeds beyond the predetermined voltage, due to the battery voltage recovery effect,~~ discharging is resumed and is repeatedly ~~carried out~~ executed until the voltage ~~becomes is returned to~~ the predetermined voltage. ~~Accordingly, the~~ The battery voltage after discharging ~~becomes is thereby made~~ stable.

[0167] Also, in the above embodiment, two setting values of the discharging current amount are provided, heaving load discharging in. ~~At the first stage is heavy load discharging, at the second stage is and light load discharging in the second stage.~~ Therefore it is possible to control the battery voltage to the predetermined voltage in ~~less a~~ shorter time period. More than two setting values of the discharging current amount can be provided.

[0168] ~~And~~ Furthermore, ~~at the in~~ in mode 2, it is possible to shifting to the charging mode by operation of an external input on the electronic timepiece ~~is possible~~, and after ~~the mode shifting~~, the operation is ~~done~~ executed in the normal hand operation state. ~~When~~ During a charging operation, when the voltage reaches the predetermined (i.e. completion) voltage level, by changing the hand movement state the a notification is made that the charging is done to the predetermined voltage level or more higher, has been achieved is made by changing the hand movement

state. The changing of the hand movement at this time is not limited to the above form, and can be arranged in any other form as long as it is possible to tell the difference of before and after charging completion.

[0169] ~~At the~~In mode 2, during the charging of the battery, ~~there is a false the observed voltage increase rise can be false (i.e. transient). Therefore~~That is, even ~~though when the observed voltage once first reaches the completion voltage level,~~ the battery voltage can ~~decline gradually fall to the a real charged voltage gradually~~ after completion of the charging (i.e. the charging operation is stopped). But, in the present embodiment, in ~~the case a situation~~ where the charging voltage ~~once reaches the charging completion voltage level if and the charging voltage then falls below the charging completion voltage level, again the hand movement again~~ returns to the normal hand movement. Accordingly, after completion of the charging, by leaving the timepiece until the false battery voltage becomes the real voltage and then confirming the hand movement, it is possible to prevent a ~~mis-judgement misinterpretations~~ due to a false voltage increase high.

[0170] In the above embodiment, if ~~detection is made it is~~ successively detected that the motor does not rotate when ~~the a~~ normal motor drive pulse is supplied, a drive pulse having ~~bigger greater~~ effective electric power than the normal driving pulse is ~~supplied applied~~. And ~~at the~~In mode 3, if the drive pulse is successively output ~~successively a predetermined number of times (or more), the judgement it is made determined that the a problem where the motor trouble of is not driven by application of the a normal drive pulse has occurred.~~ Thus the hand movement is changed, and ~~the notification of the motor trouble problem~~ is made.

[0171] ~~At the~~In mode 3, by operation of external input on the electronic timepiece, the mode is shifted to a poor quality detection mode, and the electronic timepiece is operated in a predetermined hand movement. Therefore, by changing the hand movement state of before and after this shift, it is made possible to easily confirm the mode shift.

[0172] ~~And~~Further, once the trouble is detected, the hand movement at the trouble detection is continued, therefore it is possible to easily confirm the result of trouble detection.

[0173] ~~And Also, at the in~~ mode 3, because it is possible to perceive the motor drive trouble by the hand movement, it is made possible to identify the trouble.

[0174] Also, it becomes possible to detect that the motor quality is somewhat lower than the satisfying quality but is not bad enough to cause stoppage (time keeping continuation trouble) or delay, both being difficult to detect hitherto. Therefore,

quality improvement is expected. Namely, if the motor quality is a bit poor and the detection of the non-rotation is frequently made, the motor will be driven by the auxiliary pulse having bigger effective electric power than the normal driving pulse. Therefore, time delay does not ~~happen~~ occur. ~~But~~ However, because of the frequent output of the auxiliary pulse, power consumption rises and remaining operation time is shorteneds. This kind of quality problem cannot ~~could~~ previously not be properly discovered until now due to no time delay being observed, but the mode 3 makes the detection certain.

[0175] In the above embodiment, no special check equipment is necessary to conduct the operation check function. Therefore the present invention is easily applicable to ~~the cases of~~, for example, advancing to foreign market, or assembling at several regions or places. And even after the shipment for example at the store or at the sales department or the like, it is possible to verify the timepiece operation easily.

[0176] Methods corresponding to the modes 1 to 3 mentioned above can be ~~solely~~ individually used. ~~For example~~ the following utilizations are possible.

[0177] Manufacturing and using battery voltage adjusting devices corresponding to the mode 1.

[0178] Manufacturing and using check devices or full-charge notification devices corresponding to the mode 2.

[0179] Manufacturing check devices corresponding to both of the mode 1 and 2, and using them for checking of generation unit of analog, digital, or analog-digital combination ~~electrical~~ electric timepieces.

[0180] Configuring operation check system corresponding to all of the mode 1, 2, and 3, and using them for operation checking of analog, digital, or analog-digital combination ~~electrical~~ electric timepieces.

[0181] Combining the modes 1 and 3, and using for various devices.

[0182] Combining the modes 2 and 3, and using for various devices.

[0183] Also, in the above embodiment, the operation result of each mode (states of discharging or charging or operation check result) is revealed by changing the displaying state (hand movement state) on the time displaying section. But this is not limited to the above form, and other method can be used to reveal the operation result of each mode. For example, if the timepiece has a digital displaying section, it is possible to change the displaying state from the non-displaying state to other state, and thus to enable the notification of the operation result. And if the

timepiece has a sound wave generating element or display light, by shifting of sound generation and sound non-generation, by turning the light on/off, by shifting of the sound generation state (frequency, generation cycle, or the like), or by changing the flashing period of the display light, it is possible to notify the charging state or the check result.

[0184] The embodiment of the present invention is not limited to the above embodiment. For example, the charging device for the battery is not limited to the provision as an internal unit, but can be provided as a removable unit or as an external unit.

[0185] In the above embodiment, a timepiece is exemplified with a generator of an oscillating weight or the like is driven by kinetic energy and the electricity is generated by the rotation from the oscillation weight and then by the electricity the timepiece works. But the present invention is not limited to this. Other generation methods ~~is-are~~ also possible for an ~~electrical~~electric timepiece such as ~~seizing-using~~ light energy ~~with-from~~ a solar panel, such as ~~seizing~~ thermal energy with a Peltier element, and such as ~~seizing-using~~ strain energy ~~with-from~~ a piezo element. Other method is also possible for an ~~electrical~~electric timepiece by providing electricity generated by an electromagnetic induction from outside of the timepiece, and then a stepping motor is moved by the electricity. In addition to timepieces, the present invention is applicable to stopwatches and other time keeping apparatus. And the raising and lowering circuit 49 can be omitted. In that case, the circuit driven by the output voltage VSS of the circuit 49 is driven by the output voltage VTKN of the battery 48.